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A METHOD OF COLLECTING LIVING MOTHS AT SUGAR BAIT.*

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In collecting adults of the armyworm, and other moths for oviposition studies, a simple method of capture at baits was found useful. An electric flashlight, having a flat lens, was used with a flat-bottomed vial three-quarters of an inch in diameter, straight sided and about five inches deep. It will be found that when the bottom of the vial is placed against the lens of the flashlight both can be firmly grasped in the right hand. The encircling fingers prevent the spread of light rays to the sides while full illumination is given in a narrow beam through the bottom of the vial. When this is placed over, or close to, a moth feeding at bait, the tendency is for the moth to dash towards the light. Entering the vial, it goes at once to the bottom and does not try to escape. The vial can be closed with a cork taken from the pocket with the left hand, or the moth may be examined before the vial is closed and if not wanted, it may be allowed to escape by moving the vial from the light. A number of vials may be carried in a coat pocket and a number of individual moths collected in a short time. In the closed vial the moths remain quiet for a number of hours and may be moved to breeding-cages.

The same method was found useful in collecting the large and shy *Catocala* moths. A wide-mouthed bottle was used in this case, the flashlight directed through the bottle, and chloroform or cyanide placed in the holes in the cork.

LIGHT TRAPS AS INDICATORS OF CUTWORM MOTH POPULATION.†

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Light traps have long been used to indicate cutworm moth population, but a survey of the literature reveals no instance in which light trap catches have been compared with any other source of information regarding the moth population. It has apparently been assumed by all workers, the writer included, that a light trap record furnished a reliable random sample of the population. Certain data have recently accumulated, however, which make it desirable to question this assumption, and some of these data will be presented here. This paper is chiefly concerned with three questions. 1. Does a light trap furnish a reliable qualitative record? That is, will it secure at least single examples of all species flying? 2. Do the various species come to light in proportion to their abundance in the vicinity? 3. Are light trap records reliable for comparing the abundance of a species in different years? These questions are not completely answered by collecting must be much more restricted in most cases, it may be seen that, in

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†—Contribution from the Entomology Department, Montana Agricultural Experiment Stn.

the data to be presented, but are raised in the hope that they will stimulate further investigations by throwing doubt on our present assumptions.

1. Qualitative Reliability of the Light Trap

This question cannot be completely answered at present, as there is no means of knowing how many rare species may be missed by all collecting methods. The best evidence that can be presented is that obtained by comparing collections made with light with those made at flowers. The methods used have been described elsewhere (1).

A light trap has been operated at Bozeman during the growing season for several years. During that time, many rather desultory collections in the town and in nearby canyons have failed to add more than one or two species (of night-flying Phalaenidae) to those caught by the light.

For the past three years intensive flower collections have been made at Nigger Hollow, fifty miles northwest of Bozeman. The fauna is very different, so a direct comparison is impossible, but the number of species collected at each place in each year is given below.

COMPARISON OF CATCHES AT BOZEMAN AND NIGGER HOLLOW

Year	Bozeman (Light)	Nigger Hollow (Flowers)
1925	99 species	87 species
1926	92 species	83 species
1927	*101+ species	*96+ species

* *Some of this material is not yet identified.*

This comparison would indicate either that there are more species in the Bozeman fauna, or that the light is the more efficient collector.

By means of a portable light trap (1), collections have been made at light which are directly comparable with collections from flowers. The car from which the light was operated was driven well into a patch of blossoming rabbit brush (*Chrysothamnus nauseosus*), and the light was run while collections were being made from nearby flowers. In this manner the writer made ten pairs of collections, totalling twenty hours in 1925, and twenty pairs, totalling thirty-one hours, in 1927. In my absence, Mr. C. B. Philip made four collections, totalling six and two-thirds hours in 1926. In all of these thirty-four cases, each light trap catch is exactly paralleled by a collection from nearby flowers. A summary of these records follows.

NUMBER OF SPECIES CAPTURED IN PARALLEL COLLECTIONS AT LIGHT AND FLOWERS. NIGGER HOLLOW, 1925-1927.

Year	Light	Flowers	Total
1925	38 species	51 species	59 species
1926	26 "	32 "	38 "
1927	56 "	77 "	82 "
Percent of Total	67.1	89.3	100.0

As is apparent from this table, there were several species which came to light that were not captured on flowers, and vice versa. For example, in 1927, 77 of the 82 species captured were found on flowers, leaving five that came only to light. On the other hand, 56 of the 82 species came to light, leaving 26 that did not come to light, and were found only on flowers. In all three seasons, more species were captured at flowers than at light, from which the conclusion might be drawn that about seventy percent of the species actually present at a given time will be captured at light. When it is considered that a permanent light trap may be operated for all the dark hours of an entire season, while flower

(1) Can. ent. 58: 105-108, 1926.

the longer time available for the permanent light trap, stray individuals of most of the missing species might reach the trap sometime during the flight season. On the other hand many diurnal species of Phalaenidae may be secured from daylight flower collections that will rarely or never visit a light.

In view of these considerations, it is probably safe to estimate the efficiency of the light trap at about ninety per cent., and to regard species not coming to light as making about ten per cent. of the total number of species in the fauna.

II. Quantitative Reliability of the Light Trap

This phase of the study may be subdivided. We wish to know a) whether the total catch of all species is an index of the total Phalaenid population, and b) whether the catch of any single species is proportional to its abundance. For these purposes it is necessary to analyze the thirty-four pairs of catches in more detail. For the first part of the study the total captures will be needed. As the collections vary in length, it is necessary to reduce them to terms of moths per hour, and, in order to determine the reliability of the light trap, the per cent. of total captured at light must be computed. These basic data are given in Table I.

TABLE I,

COMPARATIVE CAPTURES OF PHALAENID MOTHS AT LIGHT AND AT FLOWERS. NIGGER HOLLOW, 1925-1927.

Collection Number	Moths Per Hour At Light	Flowers	Both	% Total At Light	Collection Number	Moths Per Hour at Light	Flowers	Both	% Total At Light
1925-62	20.4	15.6	36.0	56.6	1925-90	83.0	202.5	285.5	29.1
68	6.5	63.0	69.5	9.3	97	15.4	246.3	261.7	5.9
73	6.3	28.0	34.3	18.4	120	85.6	124.0	209.6	40.8
79	25.0	162.0	187.0	13.4	124	35.5	139.1	174.6	20.3
83	13.7	185.0	198.7	6.9	133	21.0	14.0	35.0	60.0
1926-187	149.1	162.0	311.1	48.0	1926-201	55.3	216.8	272.1	20.3
190	142.0	104.2	246.2	57.6	210	92.6	146.2	238.8	38.8
1927-185	79.0	75.0	154.0	51.3	1927-223	6.0	142.0	148.0	4.0
187	15.0	54.0	69.0	21.8	231	56.0	159.0	215.0	26.1
189	2.0	46.0	48.0	4.2	235	40.0	182.0	222.0	18.0
195	23.0	102.0	125.0	18.4	238	85.0	142.0	227.0	37.4
197	36.0	67.0	103.0	35.0	240	167.0	164.0	331.0	50.5
204	10.0	122.0	132.0	7.6	242	101.0	137.0	238.0	42.5
207	29.0	125.0	154.0	18.9	245	18.0	178.0	196.0	9.2
212	21.0	190.0	211.0	9.5	248	87.0	77.0	164.0	53.0
219	111.0	103.0	214.0	51.9	251	41.0	78.0	119.0	34.5
220	145.0	125.0	270.0	53.6	254	140.0	88.0	228.0	61.4

Mean Percentage at light 29.15 ± 2.35%.

The figures per hour for flower collections are very regular in each case, and show definitely the normal curve for the August flight of Phalaenidae. Those for light are irregular, and depend upon what might be termed accidental conditions, such as variations in temperature and humidity. It is not the purpose of this paper to discuss these influences, however, and the analysis will be confined to a comparison of the rough figures, uncorrected for any outside influences. At the bottom of Table I is given the mean percentage of the total captured at light, with its probable error. This would indicate that, for a similar sample of thirty-four catches, the percentage coming to light would be between 22% and 36%. For smaller samples this range would be increased, and for larger samples it would be reduced. This mean percentage is useful chiefly in comparing a

seasonal light trap catch at one place with a series of collections at flowers at another place, which is sometimes necessary. The size of the probable error would indicate that a seasonal light trap record would total not quite one-third what a similar seasonal flower collection would show, and this factor might safely be used to calculate comparable populations in two places.

The next point to be considered is the proportion in which the individual species are attracted to light. In this study, as in the paragraph above, the light trap catches are greatly affected by weather conditions. This point will be neglected, and the average figures used, as before.

As there are nearly one hundred species involved, it would be very cumbersome to attempt to tabulate all of them, so only those species will be considered of which the total captures, at light and flowers, were over thirty-four, or one per hour. This leaves 23 species, for which the relevant data are given in Table II.

TABLE II.

RELATIVE CATCHES AT LIGHT AND FLOWERS, 1925-27.

Species	Moths per hour at Light	Moths per hour at Flowers	Total	Percent Total at Light.
Oncocnemis simplex Sm.	1.01	0.04	1.05	96.20
Euxoa dargo Stkr.	2.00	0.38	2.38	84.02
Euxoa misturata Sm.	19.05	4.41	23.46	81.15
Euxoa cicatricosa G & R	1.33	0.71	2.04	65.20
Porosagrotis orthogonia Morr.	9.08	6.10	15.18	59.90
Euxoa mitis Sm.	2.00	1.39	3.39	59.00
Euxoa cinereopallida Sm.	1.68	1.40	3.08	54.50
Euxoa oblongostigma Sm.	1.43	1.82	3.25	44.00
Euxoa laetificans Sm.	1.11	1.73	2.84	39.10
Feltia ducens Wlk.	2.30	3.63	5.93	38.78
Euxoa quadridentata G & R	0.69	1.15	1.84	37.50
Caradina atrostriga B. & McD.	0.46	0.78	1.24	37.10
Euxoa pallipennis Sm.	5.39	16.38	21.77	24.75
Euxoa plagigera Morr.	0.97	3.34	4.31	22.50
Caradrina extima Wlk.	0.44	1.71	2.15	20.45
Polia doira Stkr.	0.66	3.04	3.70	17.82
Euxoa satiens Sm.	0.36	6.75	2.11	17.09
Lampra vittifrons Grt.	0.48	3.21	3.69	13.01
Euxoa perolivalis Sm.	0.32	2.76	3.08	10.39
Euxoa albipennis Grt.	0.06	2.50	2.56	2.34
Euxoa catenula Grt.	0.59	34.00	34.59	1.72
Chorizagrotis auxiliaris Grt.	0.15	11.43	11.58	1.30
Euxoa messoria Harr.	0.08	11.44	11.52	0.69

As may be seen from the table, the various species are not attracted to light in proportion to their abundance. A large group of species are greatly attracted to light, and another large group nearly ignore the light. The species in Table II are arranged in the order of their attraction to light. No regular grouping, systematic or ecological, can be related to the arrangement. *Oncocnemis simplex* Sm., a member of the subfamily Cuculliinae, heads the list, and it may be said that several other members of this subfamily came strongly to light. The two species of *Caradrina* are from the subfamily Acronyctinae, while the others are Agrotinae. The genus *Euxoa*, which is a very compact systematic and ecological unit, is scattered from top to bottom of the list. If the species found near top and bottom of the list were captured in small numbers, their location might be due to experimental error, but this explanation does not apply to *Euxoa misturata*, near the top, nor to the three bottom species.

It must be concluded from this table that there is a wide variation in the response of individual species to light. This can be demonstrated in another

way. The parallel columns below list the ten most abundant species, in order of abundance, as shown by the light record and the flower record.

LIGHT TRAP RECORD	FLOWER COLLECTIONS
1. *Euxoa misturata* Sm.	1. *Euxoa catenula* Grt.
2. *Porosagrotis orthogonia* Morr.	2. *Euxoa pallipennis* Sm.
3. *Euxoa pallipennis* Sm.	3. *Euxoa messoria* Harr.
4. *Feltia ducens* Wlk.	4. *Chorizagrotis auxiliaris* Grt.
5. *Euxoa dargo* Stkr.	5. *Euxoa satiens* Sm.
6. *Euxoa mitis* Sm.	6. *Porosagrotis orthogonia* Morr.
7. *Euxoa cinereopallida* Sm.	7. *Euxoa misturata* Sm.
8. *Euxoa oblongistigma* Sm.	8. *Feltia ducens* Wlk.
9. *Euxoa cicatricosa* G. & R.	9. *Euxoa plagigera* Morr.
10. *Euxoa laetificans* Sm.	10. *Lampra vittifrons* Grt.

The difference in the two lists is striking. Only four species are found on both lists, and of these, only *Euxoa pallipennis* is near the same place in both lists. Obviously the two lists do not measure the same population. In order to determine the validity of the percentage figures in the final column of Table II, the probable errors were computed for four abundant species, and are given below.

Species	Percent of total at light
Euxoa misturata Sm.	81.15 ± 3.54 %
Porosagrotis orthogonia Morr.	59.90 ± 4.15 %
Euxoa pallipennis Sm.	24.75 ± 3.54 %
Euxoa catenula Grt.	1.72 ± 1.19 %

These figures show that the table in general must have an accuracy of about five percent., so that, taking twice this, above and below 30%, the general figure for light efficiency, separates species whose attraction to light is great, moderate, and small. The table has been thus divided by two lines at 20% and 40%, between which the species may be regarded as coming to light in proportion to their abundance.

III. Reliability of the Light Trap for Inter-annual Comparisons

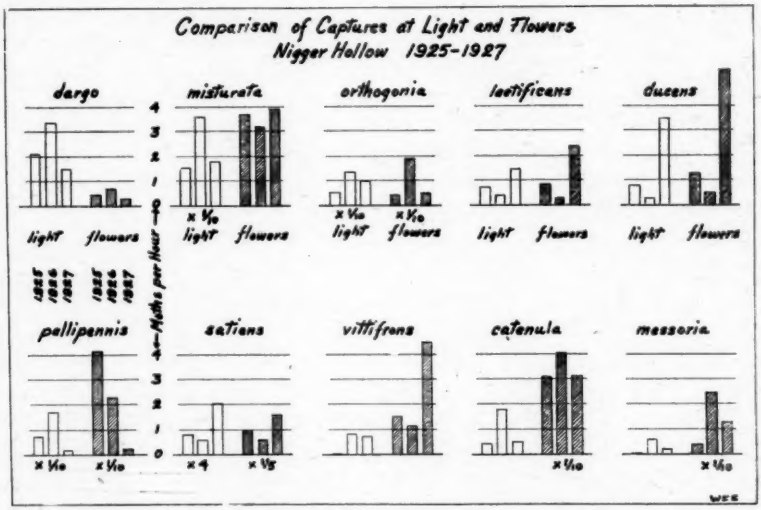
This factor may best be investigated by directly comparing the catches of various species at light and flowers in the three years of the study. For this purpose ten species were chosen which were captured in some numbers in all three seasons, and which were well distributed with regard to attraction to light. The data regarding these species are presented in Table III.

TABLE III.

INTER-ANNUAL COMPARISONS OF CAPTURES AT LIGHT AND FLOWERS

Species	Method of Capture	1925	1926	1927
Euxoa dargo Stkr.	Light trap	2.10	3.45	1.55
	Flowers	0.45	0.65	0.29
Euxoa misturata Sm.	Light trap	15.75	36.15	18.09
	Flowers	3.75	3.24	4.97
Porosagrotis orthogonia Morr.	Light trap	5.36	13.50	10.31
	Flowers	4.58	19.30	4.46
Euxoa laetificans Sm.	Light trap	0.79	0.45	1.41
	Flowers	0.82	0.32	2.46
Feltia ducens Wlk.	Light trap	0.76	0.30	3.48
	Flowers	1.30	0.49	5.43
Euxoa pallipennis Sm.	Light trap	7.46	16.80	2.07
	Flowers	41.40	22.52	2.60
Euxoa satiens Sm.	Light trap	0.20	0.15	0.49
	Flowers	5.34	3.89	8.04
Lampra vittifrons Grt.	Light trap	0.00	0.75	0.67
	Flowers	1.55	1.13	4.46
Euxoa catenula Grt.	Light trap	0.37	1.80	0.46
	Flowers	32.75	40.00	33.45
Euxoa messoria Harr.	Light trap	0.00	0.30	0.07
	Flowers	3.55	24.45	12.80

In order to show graphically the information contained in Table III, Figure 1 has been constructed, in which each of the figures of the table is represented by an appropriately shaded rectangle. In some cases the scale of one set of figures has been altered, to bring the rectangles more nearly in correspondence. When this is done, the new scale is indicated by a notation such as "light x 1/10" in the case of *misturata*.



In studying this table and figure, it must be remembered that the annual averages are of very unequal value, and, especially, that only four collections were made in 1926. For this reason, the figures for the other two years are much more reliable. Three of the species, *misturata, pallipennis* and *vittifrons,* show a very irregular relationship between the two collecting methods. In the other seven cases, however, the curves rise and fall together, with very small irregularities. From this the conclusion may be drawn that light trap catches are reliable for inter-annual comparisons. This reliability would be much greater for a seasonal record of a stationary trap than it is for these isolated short collecting periods.

Conclusions

This study, while admittedly incomplete, demonstrates conclusively that there are limits to the use of light traps as indicators of cutworm moth population.

When a sufficiently large number of catches are averaged, this average will bear a definite relation to the moth population. In this particular instance, about half as many moths are caught in the trap, per hour, as in collecting at nearby flowers. Not all the species present are captured, but probably ten per cent. of the total would escape a permanent trap.

The moths do not come to light in proportion to their abundance as species. There is a definite gradation from strongly phototropic species to those which are negative to light. Further study is needed on this point, as light traps

are very widely used as indicators of the relative abundance of species.

These short collections are fairly reliable for indicating inter-annual variations in population, and a permanent trap may be regarded as much more reliable.

OBSERVATIONS ON THE CHERMIDAE (HEMIPTERA: HOMOPTERA). PART IV.[1]

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Genus **Synoza** Enderlein.

1918. Enderlein, Zool. Jahrb., Abt. f. Syst. 41: 479.

This genus was named by Enderlein for the reception of a single species, *S. cornutiventris* Enderlein, from Peru. No indication was given as to the systematic position of the genus, but the generic characters were clearly indicated and it is evident that it belongs—on the basis of Crawford's system, at least—in the subfamily Cherminae, which is Crawford's subfamily Carsidarinae. In fact, on the basis of Crawford's keys it would apparently run to *Chermes* (=*Homotoma*). On the basis of the very brief characterization of this genus elsewhere given by Enderlein it would appear that the genus *Synoza* is sufficiently distinct by reason of the curious venation of the wings alone.

In addition to the characters peculiar to the subfamily, the genus is marked by the fusion of media and radius in the forewing, the practically complete absence of veins in the posterior wings and the presence of two curious processes on the postscutellum or pseudonotum of the metathorax (Fig. 1*D*). Enderlein has referred these structures to the first tergite of the abdomen but—accepting Crawford's interpretation of the parts—this is clearly incorrect.

There are at hand specimens representing a species that is clearly congeneric with *S. cornutiventris*. They may even represent that species, but the specific description given by Enderlein is so very incomplete that it is impossible to decide. In view of the rather wide geographic separation and an apparent difference in general color I am naming the species at hand as new.

Synoza floccosa n. sp.

Fig. 1.

MATERIAL EXAMINED. Adults of both sexes and nymphs from *Ficus* sp., near Colima, Mexico, Dec. 1925 (G. F. Ferris).

ADULT. In life of a generally pale green color. General form very slender. Length on slide 4.5-5 mm. Antennae (Fig. 1*H*) about as long as the body, strongly hairy throughout, borne upon pronounced prominences which give the head (Fig. 1*G*) the characteristic appearance of the subfamily. The head is without the slightest indication of genal cones, but there is a small epiphysis at the antennal base.

Thorax of the general type seen in the Psyllinae as figured by Crawford in his monograph of the new world species, the pleural suture of the prothorax not attaining the extremity of the pronotum. The pair of curious prominences on the postscutellum of the metathorax (Fig. 1*Dx*) are prominent features. Pos-

1.—Continued from Canadian Entomologist 58: 13. (1926).

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Fig. 1. *Synoza floccosa* n. sp. A.—Fifth stage of nymph; B.—Antenna of nymph; C.—Apex of tarsus of nymph; D.—Junction of thorax and abdomen of adult; E.—sectaseta; F.—Portion of circum-anal pore ring; G.—Head of adult, left side dorsal, right side ventral; H.—Antenna of adult; I.—Fore wing; J.—Posterior wing; K.—Apex of posterior tibia of adult; L.—Genitalia of male; M.—Genitalia of female.

terior tibiae without a basal spur and with a comb of stout black setae at the apex (Fig. 1*K*). Posterior tarsi with a pair of claw-like spines on the basal segment.

Anterior wings (Fig. 1*I*) hyaline, the veins quite dark. Media is united with radius throughout a great part of the length of both, thus giving to the wing a curious venational pattern. The veins are sparsely beset with small, fine setae. Hind wings (Fig. 1*J*) very small, venation practically entirely lacking.

Abdomen with the tergal and sternal plates moderately sclerotic, without sculpture. Genital segment of the female (Fig. 1*M*) relatively small, the anal opening relatively very large and surrounded by an apparently simple pore ring. Genitalia of male (Fig. 1*L*) with the claspers quite deeply bifid, the anterior branch sharply pointed.

NYMPH (Fig. 1*A*). In life occurring on the under surfaces of the leaves and enveloped in masses of flocculent secretion. Length on slide 3 mm. The body is of the general psylliine type, that is with the wing pads not produced forward and partially enclosing the head. The derm is membranous throughout except for an ocular patch, the wingpads and a small dorsal caudal area, and rather sparsely beset with slender setae. The caudal area bears at its margins and in a pair of clusters on the dorsal side numbers of small, sharply pointed sectasetae (Fig. 1*E*) and a single sectaseta appears at the lateral margin of each abdominal segment. There are apparently no dorsal pores to account for the enormous masses of wax that are secreted. The circum-anal pore ring is entirely on the ventral side and is considerably expanded (Fig. 1*F*). Antennae Fig. 1*B*) short, consisting of three segments, of which the third is very long. Legs without trochanters. Tarsi with a very small empodium (Fig. 1*C*).

Notes: The knowledge of the nymphs of this family is still too fragmentary to permit any conclusions concerning the evidence they may afford as to relationships. I would merely call attention to the fact that this nymph bears extremely little resemblance to that next to be described, although on the basis of the existing classification the two species are referred to the same subfamily.

Genus Freysuila Aleman.

There are at hand specimens representing a single species of this genus. I can not force these into any existing species and am consequently describing them as new. As far as I am aware the nymph has not been described in any species of this genus. All the species thus far recorded have been taken from trees of the genus *Cedrela* but specimens at hand indicate that the group is not actually thus limited.

Freysuila cohahuayanae n. sp.

Fig. 2.

MATERIAL EXAMINED. A single mature female and many nymphs from *Cedrela* sp. near Cohahuayana, Michoacan, Mexico and a single teneral male and numerous nymphs from *Ficus* sp. near Colima (*G. F. Ferris*).

ADULT. According to the key given by Crawford in his monograph of the new world species, this differs from the other species of the genus, with the exception of *F. ernstii* Schwarz, in having the third and fourth antennal segments equal. From *ernstii*, which was recorded from Venezuela, it appears to differ in the paler wing veins.

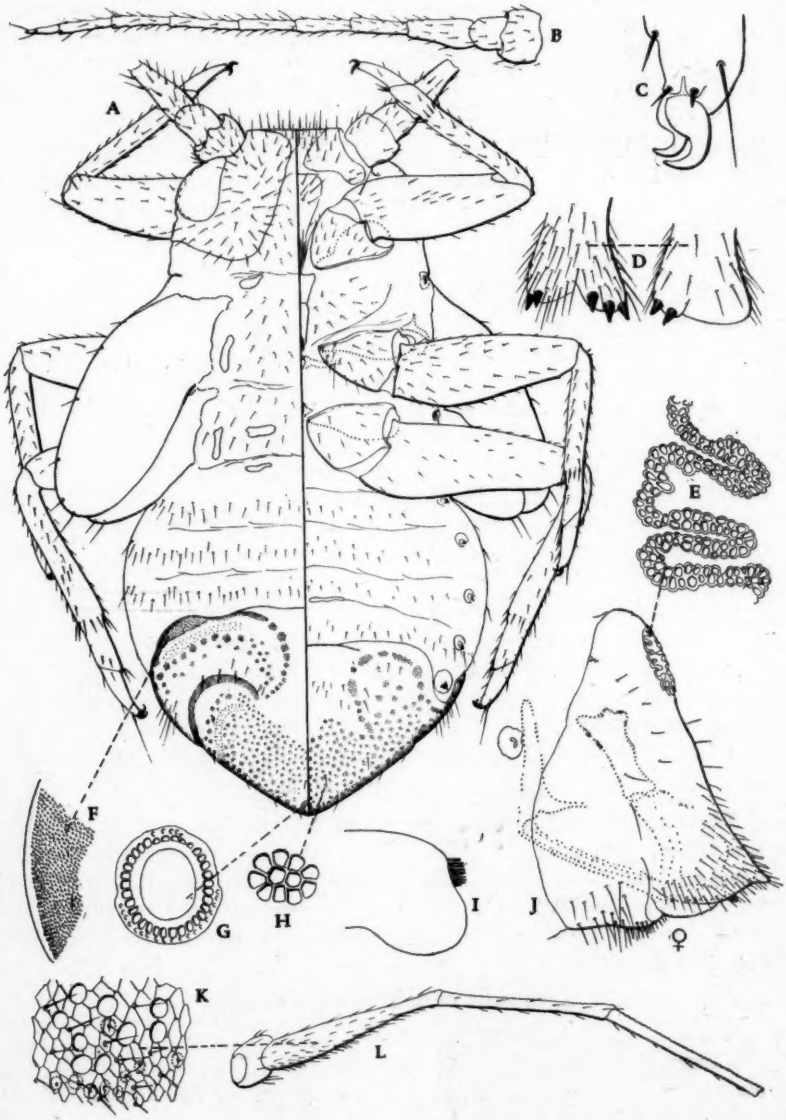

Fig. 2. *Freysuila cohahuayanae* n. sp. A.—Nymph of fifth stage; B.—Antenna of nymph; C.—Apex of tarsus of nymph; D.—Apex of posterior tibia of adult; E.—Portion of circum-anal pore ring of adult; F.—Portion of pore area of nymph; G.—Circum-anal pore ring of nymph; H.—Pore cluster of nymph; I.—Apex of posterior femur of adult; J.—Genitalia of female; K.—Markings of third antennal segment of adult; L.—Second to fifth antennal segments of adult.

Antennae (Fig. 2*L*) broken in the single available specimen, the terminal segments lacking. The third segment is swollen, as is common in the genus. The entire antenna is closely imbricate or reticulate and the third segment (Fig. 2*K*) bears numerous small, circular areas that are apparently sensoria and that are of two kinds, one an open pit, the other a pit that opens only by a minute pore.

The head is of the common type of the genus, the genae being produced into very slight prominences. Wings of the common type, M+Cu equal to R. Posterior femora with a cluster of small, fleshy setae at the apex (Fig. 2*I*). Apex of posterior tibia with five stout black setae on one side and two on the other (Fig. 2*D*).

Genitalia (Fig. 2*J*) quite short, the dorsal valve descending sharply and much exceeding the ventral valve. The pore ring surrounding the anal opening is peculiar in that it is much convoluted and is composed of an irregular double row of pores (Fig. 2*E*).

The single available male was dissected from a nymph and is consequently too broken and too incompletely formed to permit description. It is placed with this species because of the identical character of the nymphs.

NYMPH. (Fig. 2*A*). In life covered with masses of cottony secretion. Length on slide 3 mm. Of the psylliine type, the wing pads not produced forward. The derm is for the most part membranous except for the usual ocular patch, small areas on the dorsum of the thorax and the very large caudal area which occupies nearly half the abdomen.

Antennae (Fig. 2*B*) ten-segmented, slender, clothed with small setae. Legs without trochanter and apparently without empodium (Fig. 2*C*). Body bearing numerous fine setae but entirely without sectasetae or setae of any other modified form.

Anal opening at the extreme tip of the body, enclosed within a very small pore ring (Fig. 2*G*). The caudal sclerotic area is thickly beset both dorsally and ventrally with simple pores which are arranged in bands and in small clusters (Fig. 2*F* and 2*H*).

Notes: I have already called attention to the very great difference between the nymph of this species and that of *Synoza floccosa*, although under the existing classification the two would be referred to the same subfamily. Conversely I would call attention to the close resemblance between this nymph of *Freysuila cohahuayanae* and that of the two species still to be described, which would be placed in a different subfamily.

I am unable to undersand Crawford's statement[2] that the members of this subfamily, with the exception of *Chermes* (=*Homotoma*) have but one black claw-like spine on the basal segment of the posterior tarsi, for in this species there are clearly two.

Genus Euphalerus Schwarz.

Four species have been described in this genus from the new world and several from the old world tropics. The type of the genus, *E. nidifex* Schwarz, in its larval stages forms a waxen cell but the nymph itself has not been described. Specimens of the nymph of this species are available, but represent only early stages. They are sufficient, however, to show that the species here to be described agrees with the generic type quite closely in its nymphal characters as well as in those of the adult.

2.—Crawford, D. L. Philippine Jn. Sci. 15: 156. (1919).

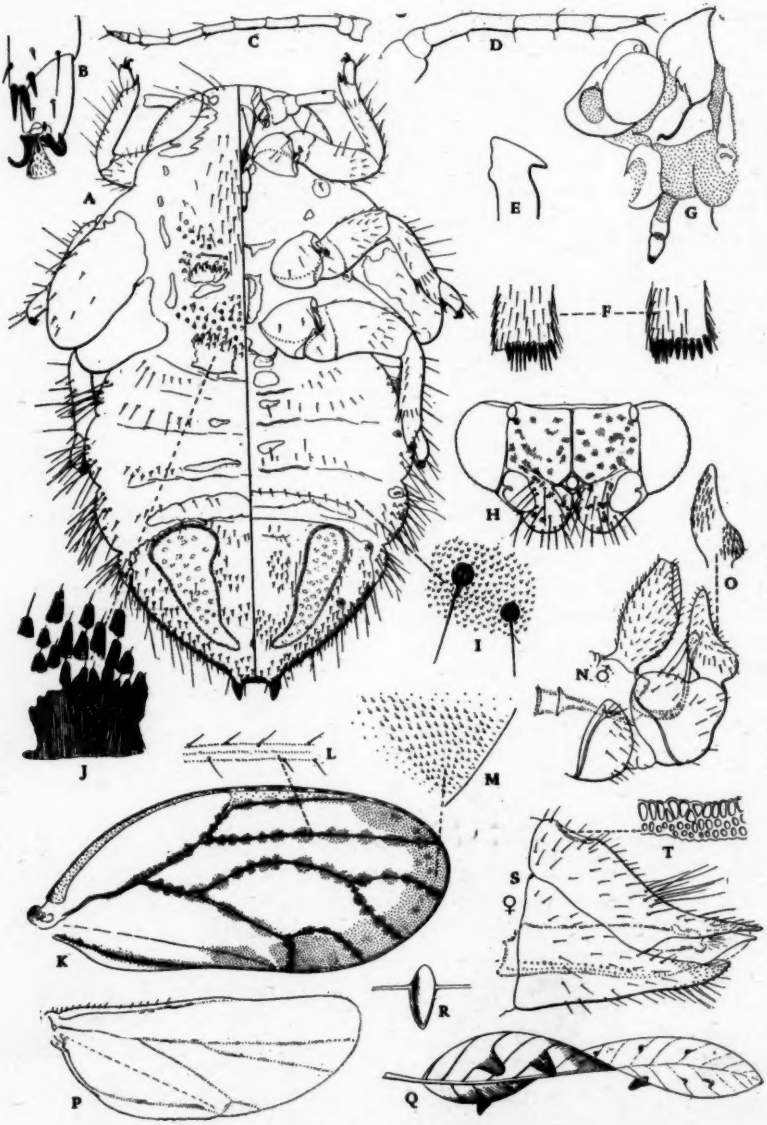

Fig. 3. *Euphalerus gallicolus* n. sp. A.—Fifth stage nymph; B.—Apex of tarsus of nymph; C.—Antenna of nymph; D.—Antenna of third (?) stage of nymph; E.—Base of posterior tibia of adult; F.—Apex of posterior tibia of adult; G.—Head and prothorax of adult; H.—Head of adult; I.—Portion of derm of nymph; J.—Dermal ornamentation of nymph; K.—Fore wing; L.—Portion of vein of fore wing; M.—Portion of marginal area of wing; N.—Genitalia of male; O.—Inner face of clasper; P.—Posterior wing; Q.—Leaf with galls; R.—Section of gall; S.—Genitalia of female; T.—Portion of circum-anal pore ring of female.

Euphalerus gallicola n. sp.

Fig. 3.

MATERIAL EXAMINED. Adults and nymphs from a tree of the family Rhamnaceae, possibly *Karwinskia humboldtiana,* at Manzanillo, and nymphs only from some plant, possibly of the same family, from near the mouth of the Balsas River, Mexico (*G. F. Ferris*).

ADULT. In life of a pale brown color, quite uniformly maculated with small dark spots, the wings (Fig. 3*K*) with small maculations along the veins and with a terminal border of darker color.

Antennae about half as long as the body. Head (Fig. 3) with the typical form of the genus, the genal cones short, broad and rounded and bearing numerous rather large setae. The outline of head and prothorax is shown in Fig. 3*G*.

Wings hyaline except for the maculations, broadly rounded at the apex, the veins (Fig. 3*L*) bearing numerous very small setae. At the wing margin in each cell is a cluster of small, dark points (Fig. 3*M*). Hind wings (Fig. 3*P*) comparatively large, uniformly beset with minute black dots, the veins, although weak being clearly defined. The venation is apparently complete except for the absence of the radius.

Posterior tibiae with a very pronounced spur at the base (Fig. 3*E*) and with several short, black setae at the apex on both sides (Fig. 3*F*). Genital segment of female (Fig. 3*G*) acutely pointed, the apices bearing numerous extremely small setae; circumanal pore ring composed of an irregular band of pores (Fig. 3*I*). Genitalia of the male (Fig. 3*N*) with the claspers pointed and swollen at the base, their inner face (Fig. 3*O*) with numerous small, stout setae.

NYMPH (Fig. 3*A*). Living within galls formed upon the leaves of the host. These galls (Fig. 3*Q*) are always formed on a vein, there being a conical portion on the lower side of the leaf and a low prominence on the upper side which forms two lips that open to allow of the escape of the nymph. A section of a gall is shown in Fig. 3*R*. Within the gall the nymphs are enclosed in a mass of cottony wax. They leave the gall before the time of the last molt and this is performed upon the surface of the leaf.

Nymph of the fifth stage about 3 mm. long on the slide. The antennae (Fig. 3*C*) are quite short but slender and ten-segmented, practically bare of setae. The derm of the body is apparently quite thick and, except in the sclerotic areas, is beset with minute points (Fig. 3*I*). The dorsum of the thorax is marked by numerous small, sclerotic areas, the tips of which form free points and are usually armed with a small seta. These areas are partially united into larger plates (Fig. 3*J*), the whole giving a very characteristic appearance. The caudal sclerotic area is large, occupying more than a third of the abdomen and is deeply pigmented. The abdomen terminates in a pair of short processes, between which is the anal opening. This opening is more or less concealed by the deep pigmentation and by the fact that it is slightly retracted into the body, but in a favorable specimen it is possible to determine that it is surrounded by a simple pore ring as is the case in the previously described *Freysuila cohahuayanae,* although I am not able to give a figure.

The caudal sclerotic area bears both dorsally and ventrally a large ring composed of crowded, minute, simple pores and enclosing a smooth region.

The body is beset rather sparingly with small slender setae, these becoming more numerous and longer along the margins of the abdomen.

The legs are quite short and stout, showing a fairly distinct trochanter. The tibia bears at the inner apex two or three short, stout setae, the tarsus is very short and bears a small empodium (Fig. 3*B*).

Notes: This species is apparently closest to *E. nidifex,* from which it may be separated by the different arrangement of the maculations of the wing.

There occurred upon the same host at Manzanillo nymphs of what is almost certainly another species of *Euphalerus,* perhaps *nidifex* itself, forming the characteristic waxen cells. It is possible that the adult here described belongs with this other nymph, but I think not, for an adult was dissected from one of the gall inhabiting nymphs and this adult agrees entirely with fully developed individuals in all the characters that could be compared.

Genus Euphyllura Forster.

I have in an earlier paper dealt with the nymph of *Euphyllura arbuti* Schwarz but I do not now regard that treatment as adequate and shall here

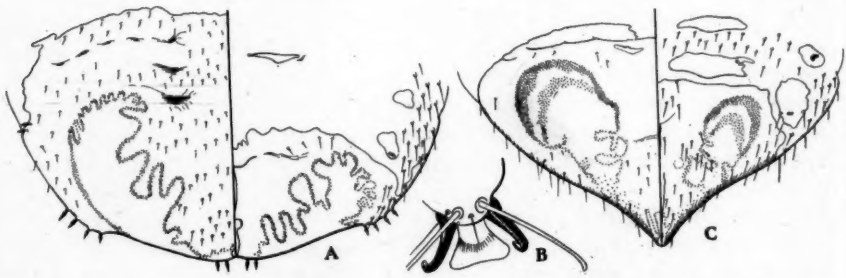

Fig. 4. *Euphyllura arctostaphyli* Schwarz. A.—Apex of abdomen of nymph. *Euphyllura arguti* Schwarz. B.—Apex of tarsus; C.—Apex of abdomen of nymph.

present further notes. This is done partly in order to permit a closer comparison of the nymphs of this genus with others which are here dealt with.

Euphyllura arbuti Schwarz.

Fig. 4A, 4B.

1923. *Euphyllura arbuti* Schwarz, Ferris and Hyatt, Can. Ent. 55:88-92.

The figures previously given do not show with sufficient clarity the details of the circum-anal pore ring. The anal opening is at the extreme tip of the body and the pore ring has become enormously enlarged, forming a sinuate and narrow band on both dorsal and ventral sides as indicated in the figure.

The tarsi bear a very small empodium (Fig. 4*B*).

Euphyllura arctostaphyli Schwarz.

Fig. 4C.

Nymphs are at hand, taken from *Arctostaphylos* on Mt. Hamilton and near Stanford University, California, which in all probability represent this species, although adults are not available with which to confirm the identification.

In life this species is covered with cottony secretion and does not form a cell as does *E. arbuti.* The nymph is very similar to that of *arbuti* in its general character, differing chiefly in the form of the posterior portion of the abdomen (Fig. 4*C*) which is almost truncate. The circum-anal pore ring is expanded as in *arbuti,* but is even more sinuate and in general is narrower.

THE HOMOLOGIES OF THE ANAL PORE RING.

Enough nymphs of this family have been described in this series to make possible the formulation of some statements concerning certain of their structures.

One of the peculiar features of this group is the circum-anal pore ring which is present in the nymphs of apparently the greater number of species. This ring occurs also in the adult female, but apparently not in the male. In some groups, such as the genus *Pachypsylla,* it appears to be lacking in the nymphs. Whether or not it is also lacking in the adult female I cannot determine from the scanty material of this group that is available to me for examination. Apparently no use has been made of this ring in the description of the adults, but it evidently has some value and needs to be taken into consideration.

In the nymphs, this ring, when present, occurs in all the stages. It varies greatly in its size, form and make-up, as can be seen by reference to the figures that have thus far been presented. Typically, one may say, the anal opening in the nymph is on the ventral side of the body, somewhat removed from the apex, and the ring is also ventral. In some forms, however, the anal opening is at the extreme apex of the body and the pore ring is partially on the dorsum and partially on the venter.

In addition to this shift in position, and apparently frequently coincident with it, the character of the ring changes. From a simple ring of pores it becomes expanded into a large zone that may even lose much of its obvious resemblance to the simple ring. Such is the case in the species of *Euphyllura* here figured. Nevertheless, I am convinced that here the homology is still clear.

In the case of the species of *Freysuila* and *Euphalerus* here figured I am not so sure that the conspicuous bands of pores are really homologous with this ring, although I am disposed to think that they are. It may be noted that in both these species the anal opening is surrounded by a very small ring which is in addition to the other pore areas. It is not impossible that this is the true circum-anal ring and that the other pore areas are additional structures. Especially would this seem to be possible in the case of the nymph of *Euphalerus gallicola* where the pore areas are entirely dissociated from the anal ring.

It would seem reasonable to suppose that a structure such as this should be of considerable systematic importance and doubtless it is. But it is evident that care must be taken in its use to establish the actual homologies and only the study of a much longer series of forms can permit of this.

ADDITIONS TO ANNOTATED CHECK LIST OF THE MACROLEPIDOPTERA OF ALBERTA.

BY KENNETH BOWMAN,
Edmonton, Alta.

15 *Papilio daunus* Bdv. .....6. W.
N.S. *Eurymus pelidne* f. ♀ *isni* B. & B. ..... 8 L.

57	*Eurymus hecla hela* Stkr.	7	B.
N.S.	*Argynnis nevadensis calgariana* McD.	7, 8	C.R.N.Lb.W.
N.S.	*Argynnis atlantis beani* B. & B.	8	B.
N.S.	*Sphinx mordecai* McD.	6	Bm.
687	*Sphinx chersis* Hbn.	6	Mh.
N.S.	*Paonias myops occidentalis* Clark	6	Lb.H.
1069	*Melicleptria persimilis* Grt.	8	C.
N.S.	*Euxoa cooki* McD.	8	C.
N.S.	*Abagrotis dodi* McD.	7	C.
N.S.	*Scotogramma alta* B. & B.	5-7	P.N.
1629	*Anarta leucocycla albertensis* McD.	7	N.
N.S.	*Anarta lagganata* B. & B.	7,8	L.
N.S.	*Oncocnemis mackiei* B. & B.	8	E.
2136	*Graptolitha disposita* Morr.	9	Fort Mackay.
2311	*Trachea commoda alberta*	6, 7	N.B.
2400	*Chytonix palliatricula* Gn.	6	E.
N.S.	*Gortyna intermedia* B. & B.	8	C.
2711	*Stibadium spumosum* Grt.	8	Lb.
2769	*Plagiomimici expallidus* Grt.	8	Lb.
2784	*Bellura obliqua pallida* B. & B.	7, 8	R.E.
2898	*Lithacodia bellicula* Hbn.	6	E.
2900	*Lithacodia carniola* Gn.	6	E.
N.S.	*Syneda heathi* B. & McD. (*pedionis* Hamp.)	7, 8	D.
3625	*Dasylophia anguina* A. & S.	7	Lb.
3671	*Cerura cinerea cinereoides* Dyar	6, 7	Lb.
3767	*Alsophila pometaria* Harris	10	Lb.
3912	*Haematopis grataria* Fabr.	6	C.
3997	*Dysstroma ethela* Hlst.	8	H.
4149	*Eupithecia cimicifugata* Pears.	6	E.
N.S.	*Macaria perplexa* McD.	6	B.
4357	*Phasiane californiaria* Pack.	7	Cardston
4377	*Phasiane snoviata* Pack.	7	Lb.
4405-1	*Itame andersoni* Swett.	7	N.
4462	*Sericosema juturnaria* Gn.	8	W.
4557	*Stenoporpia separataria* Grt. (*umbraria* McD.).	6	W.
4672	*Plagodis fervidaria* H. S.	6	E.
N.S.	*Hepialus novigannus mackiei* B. & B.	8-10	E.C.P.

DELETE FROM LIST

171 *Argynnis nevadensis meadi* Edw.
1617 *Scotogramma oregonica* Wlk.
Scotogramma oregonica morana Sm.
2070 *Oncocnemis colorado* Sm.
8488 *Hepialus mathewi* Hy. Edw.

KEY TO THE SPECIES OF DICYPHUS OCCURRING IN EASTERN NORTH AMERICA (HEMIPT., MIRIDAE).*

BY G. STUART WALLEY,
Ames, Iowa.

In attempting to determine specimens of *Dicyphus* using Blatchley's key (Heterop. East. N. Am. 1926, p. 908) difficulty was encountered and the following key is presented to facilitate the identification of the species occuring in Eastern North America. It has already been demonstrated by Knight (Bull. Brook. Ent. Soc., XXII, 1927, p. 104) that *D. notatus* Parshley is a synonym of *D. vestitus* Uhler and that *D. gracilentus* Parsh. should not be confused with *vestitus* Uhl. To Dr. H. H. Knight the writer is indebted for specimens upon which the following key is based including paratypes of *D. notatus* Parsh., *D. gracilentus* Parsh. and *D. discrepans* Kngt.; also a specimen of *D. minimus* Uhl. compared with a cotype of *minimus* Uhl. and specimens of *D. vestitus* Uhl. from Colorado.

KEY TO SPECIES

1. Length not over 3 mm.; basal margin of pronotum but feebly concave; corium with a large black spot near apex ..... *minimus* Uhler.
   Length more than 4 mm.; basal margin of pronotum distinctly concave; corium variously marked but without a large black spot near apex ..... 2.
2. Head and pronotum dark brown to black, the latter with a pale median longitudinal stripe ..... *agilis* Uhler.
   Head pale at least on vertex behind eyes; pronotum in greater part dull yellow or reddish with only the sides darkened ..... 3.
3. Second antennal sub-equal to both greatest width and greatest length of pronotum ..... *vestitus* Uhler.
   Second antennal at least one-third longer than greatest width of pronotum and at least one-half longer than greatest length of pronotum ..... 4.
4. Second antennal uniformly black; scutellum in greater part blackish; femora without reddish dots ..... *gracilentus* Parshley.
   Second antennal with basal two-thirds pale; scutellum reddish or yellowish never blackish; femora with numerous reddish dots ..... 5.
5. Elytra with numerous reddish streaks; post-ocular space sub-equal to distance between eyes ..... *famelicus* Uhler.
   Elytra without reddish streaks; post-ocular space slightly more than one-half distance between eyes ..... *discrepans* Knight.

REVISION OF THE GENUS ODONTAEUS, DEJ. (SCARABAEIDAE, COLEOPTERA).

BY J. B. WALLIS,
Winnipeg, Man.

This study of the taxonomic units comprising the genus *Odontaeus* Dej. has occupied, for the past three years, by far the greater part of such time as I can devote to entomology, and yet it is with a feeling of dissatisfaction that the following conclusions are offered to coleopterists.

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*—Contribution from the Department of Zoology and Entomology, Iowa State College, Ames, Iowa.

Dealing with a genus comprising, in North America, but three recognized species, it seemed reasonable to suppose that, when these three had been definitely placed, such new species as might be found would be easily defined. This view was indeed supported at first by the study of a limited amount of material, but as each fresh consignment came in, difficulty after difficulty arose until I reluctantly concluded that the genus consists of species extraordinarily variable within themselves, often very similar to others, and in most cases determinable with certainty only from comparison of the male genitalia.

Take for instance the species hereinafter described as *simi*. No one seeing extremes of this series could for one second associate them. There is a male 7.49 mm. long and 4.83 mm. wide, with a long horn, profound thoracic foveae and large elevations. There is a male 5.18 mm. long and 3.29 mm. wide, absolutely hornless and with thoracic sculpture as in the female.

Darlingtoni sp. nov. shows even greater extremes from 8.19 mm. x 5.32 mm. to 5.25 mm. x 3.36 mm. and the specimens compared both of *simi* and *darlingtoni* were taken at the same place approximately at the same time.

These "minor" males at their lowest development vary away from even the females in sculpture; the puncturation often becoming much finer, shallower and sparser throughout.

In the paper following, size of type only is given and this is almost certainly—except in the case of *floridensis* sp. nov.—not far from the maximum for the species concerned.

Variations in structural characters common to the sexes; shape and puncturation of clypeus, shape of pronotum, striae of the elytra and their punctures, even the relative lengths of the tarsal joints, are easy to note, but so far I have been unable to correlate these with each other, or with genitalic characters so as to define species within the *liebecki, darlingtoni,* etc. complexes.

Especially in the *liebecki* complex, variations may be found in the shape of the middle lobe of the male genitalia. These, however, are so slight and so difficult to correlate with other characters that it has seemed to me safest to disregard them or to assume that they are the result of damage caused by pressure in extraction, or of distortion in drying.

While it is quite possible that later studies, especially of the larvae, pupae and habits of these insects, may show that some of the species listed below are composite, I feel confident that these as given are really distinct. In designating holotypes, therefore, I have preferred to use relatively extreme specimens rather than the mean so that should division become necessary later it will be so much the easier.

The genus *Odontaeus* was first described by Klug in 1843 (Abhandl. d. k. Akad. d. Wiss. z. Berlin pp. 21-57) and in consequence is usually credited to him. Megerle used the name in manuscript long before this and it first appeared in the Dejean Catalogue, Edition 2, 1821, where it was attributed to Megerle. Since Megerle's use of the name was clearly only in manuscript while Dejean listed species under it, the authorship of the genus must be credited to the latter. Apparently no type has been designated for *Odontaeus* but as the literature to make this entirely certain is not available, the matter is left as it is.

In 1823 Say described *Geotrupes filicornis* saying that it belonged to the genus *Odontaeus*. F. E. Melsheimer in 1845 described *Bolbocerus* (*Scarabaeus*) *cornigerus*, and in 1859 Dr. J. L. LeConte described *obesus*. The three species were brought together and to some extent compared by Horn in Transactions of the American Entomological Society, Vol. III.

Profesor H. F. Wickham (Can. Ent. Vol. XXVI, p. 206) gives *cornigerus* Melsh. and *filicornis* Say, as being representatives of *Odontaeus* in Old Canada. The characters used to separate them are, however, entirely unreliable and it is not possible to say to what species the specimens belonged.

Professor W. S. Blatchley listed and redescribed two Indiana species as *filicornis* and *cornigerus* in his fine work, "The Coleoptera of Indiana."

After a mere glance at a few specimens it was quite obvious that no certainty existed as to the identity of *filicornis* and *cornigerus*. Specimens identified by Dr. Horn himself were clearly incorrectly named, if his own work, cited above, was used. The first thing to do then was to establish the identity of *cornigerus* and of *filicornis*.

Situated as I am hundreds of miles from either a good entomological library or a reference collection this could not have been done but for the generous assistance of entomological friends more fortunately situated. Dr. H. C. Fall and Mr. P. J. Darlington Jr. looked through the collections at Cambridge and found Melsheimer's type of *cornigerus*. Unfortunately, the abdomen of the specimen had disappeared but Mr. Darlington selected a male taken at Highlands, N. C., from the Blanchard collection and both he and Dr. Fall pronounce it to be identical with Melsheimer's specimen. This male is now labelled "Homotype."

It was more difficult to decide upon *filicornis*, Say. Say's specimens were destroyed long ago and his description would fit several species. Dr. Fall suggested that an examination of the Harris collection be made and this Mr. Darlington very kindly undertook. He wrote to me concerning this as follows:

"There are four specimens under "*Odontaeus*" in the Harris collection; none has been to Say, but all are labelled, or numbered, *filicornis*. Only one is a male, taken Cambridge, (Mass.), July 15th, 1835, according to his notebook. The horn is fixed ....." (P. J. D. in litt. January 14th, 1926).

In spite of Dr. Horn's statement (Transactions of the American Entomological Society, Volume III) that the horn in *filicornis* is movable, there is nothing in Say's description—quoted later—to this effect. It was conceivable therefore, that Harris might have called his specimen with fixed horn *filicornis* on Say's authority. I finally rejected the possibility of this being *filicornis* on the grounds that its recorded locality was so far away from Say's type locality and that I had nothing from the type region comparable with the Harris specimen, whereas I had a fair series from Medora, Kansas, a locality about directly intermediate between the two localities mentioned by Say, which fitted the description equally well. This species has a movable horn, thus agreeing with Horn's statement, a statement quite likely founded on tradition. The best course, therefore, to me appeared to be the citation of this Kansas species as *filicornis*, Say, and a specimen has been designated as "Neoholotype."

Obesus presented no difficulty. It is the only species of the genus known from the type locality and appears to be fairly common.

But little is known of the life history of these secretive insects. So far as I have been able to ascertain the egg has never been noted, nor has anything as yet been published dealing with the larva or pupa.

Most specimens taken by the ordinary collector appear to be captured at light and this accounts for their apparent rarity for assuredly they are really at least relatively common. From observations of our local species, they do not readily fly to light but when attracted fly *around* it and fall to the ground some feet away, when they are usually difficult to discover.

Mr. R. J. Sim, by far the most successful hunter of these beetles, digs his material out and has made the following observations on his three local species.

"I get the *Odontaeus, Eucanthus lazarus* and *B. farctum*—all rather plentifully from our golf courses; *B. tumefactum* occasionally. All four along one or two old roads—where they burrow into the sides of deep wheel-ruts. *Odontaeus;* a few digging in wood-paths.

"They all work about alike; make a vertical burrow from two to fifteen inches deep, pushing to the surface a pile of sand "sausages," the diameter of the hole. The deeper the hole the bigger the pile—sometimes two or three inches in diameter. *Odontaeus* seems more inclined to branch off laterally and sometimes a pair or three or four are found in the ground under a single 'push-up.' Have occasionally found a *Bolbocerosoma*, a *Eucanthus* and an *Odontaeus* in the ground beneath a single entrance.

"In one yellow-sand road through the edge of the Pine Barrens I saw two little 'push-ups' an inch or so apart. From the ground underneath, in less than a square foot, eight or ten *Odontaeus* were taken.

"Have never seen one in flight or above ground, and have had no luck in finding eggs, larvae or pupae." (R. J. Sim, in litt. IX. 27. 26.).

"Those marked 'Rancocas' are from burrows from the sides of an old sand road in rather open country.

"The ones from 'Rancocas Park' are from the pretty deep shade of old Scrub Pines in a small 'Pine Barren Island' a few miles outside the big, continuous Pine Barrens proper. The ground is an inch or so deep with pine needle humus, but beneath this is pure yellow sand. These fellows have continued work all winter, pushing up fresh sand on each warm day. The female taken yesterday (12.V.27) looks a bit pale and new, but she was in an old burrow that has been kept open for several months!

"Most of those marked Riverton, Merchantville and Pine Valley are from greens and fairways of golf courses right out in the open. No evidences of digging have been seen in the courses in late fall, winter or spring." (R. J. Sim in litt., IV.13.27).

"First let me say that in the mind of your digging Odontaeus the prime *intention* is for a vertical burrow. A perfectly vertical burrow. In the pure sand region of Rancocas Park it is usually possible for the beetle to carry out this intention though occasionally a pine root deflects the direction somewhat. In this place the ground is thus: first (on the surface) a carpet of recent red-brown pine needles, then maybe an inch of black humus; below that, from three to ten

inches of firmly packed grayish-white sand; from that on indefinitely a peculiarly loose bright yellow sand. The beetles go down into this yellow sand, with the result that the outside or visible parts of a push-up are quite conspicuous. The beetles seem to work in pairs and when the burrow is a foot or more deep they carry down a mass of the black humus and form a firmly packed elongated mass of it. So far as I have been able to make out, this is simple—not two or three branched as in *Strategus septentrionis* Csy. In this I think the female lays an egg or perhaps more—though I've never found any. In the golf courses there is (Riverton and Merchantville) more clay in the soil and deeper humus, but the beetles' actions are apparently the same.

Now in the *liebecki* localities the soil is pretty purely clay with numerous pebbles and rock fragments. In the ground of Arney Mountain the rocks are fewer or absent, but on the hills at Langhorne, Pa. and the Jenny Jump Mountains in North Jersey the stones are so numerous that a burrow may be very irregular in its downward course. Too, the clay is more firm and difficult to dig though. So as I recall them the beetles were found from one inch to six or eight inches down.

At Arney Mountain the beetles have been discovered working in and near an old road some distance from the top of the hill.

At Langhorne they were found among large maples, oaks, etc. on a slope below the top and also among spindling maples and red cedars on a flat area of the top of one hill and along an old road through deciduous forest on the neighboring hill.

At Jenny Jump the burrows were through a dead leaf carpet on a slope (covered with mostly young deciduous trees) not far below top and in an old road through deciduous wood near top of another hill."

Mr. Sim's observations seem to indicate considerable difference in habits; the species from Rancocas Park being adult and active much of the year with probably a period of at least partial disappearance during early or mid-summer; the species from Merchantville appearing only during the summer. As was to be expected this difference in choice of habitat correlated with the difference in period of adult activity, indicated difference in species and the specimens from the shade of the Scrub Pines in Rancocas Park proved to be almost all the species described later herein as *"darlingtoni"* while those coming from Merchantville, Riverton and Pine Valley were the new species *"simi."*

Our local species, described later as *"falli,"* inhabits—as one would expect from its black color—somewhat richer land than those taken by Mr. Sim. Mr. Criddle finds them near his home at Aweme, Manitoba, along a road through the aspen poplars, where the soil is a rich, dark sandy loam. They appear never to occur on the more sandy uplands a few yards away or on the bare sand which, too, is quite close.

I have taken *"falli"* from burrows on rather dry ridges of dark sandy clay near Russell, Manitoba and from an old road in a rather damp situation with soil of the same dark sandy clay near Foxwarren, Manitoba. These burrows seem never to be more than a few inches deep.

Falli occasionally comes to light at Winnipeg, or rather flies around light, rarely if ever coming directly to it, but circling it and falling to the ground some

feet away. On one occasion when sugaring for moths in a rich wood, I noticed a small area of the leaf humus undulating in a most vigorous and extraordinary manner. On rolling the piece of mould off like a blanket, a seething mass of *Odontaeus* was found beneath, rolling, crawling, clinging. About seventy specimens were taken in a space not more than eight inches square. They varied much in maturity some being soft and pale, others hard and black, and appeared to have gathered for mating purposes, as many of the males had the genitalia partly exposed.

Professor W. S. Blatchley speaks of *cornigerus* Melsh. as being taken under logs and other cover, and of *filicornis* Say as being found under logs, ("Coleoptera of Indiana"—page 938) while the types of *"liebecki"* were taken by Mr. K. F. Chamberlain at Cornwall Bridge, Connecticut, under "wash-up."

It seems probable that careful search in the early morning for the tell-tale "push-ups"—along sandy or clayey roads, amidst sparse vegetation, in fact almost anywhere where the "push-ups" would be visible—would result in the discovery that most if not all of the species of these interesting and secretive beetles are really rather common.

There seems to be no way of distinguishing with certainty between the sexes except by extraction of the genitalia. In some species the clypeus in the female is usually longer from front to back, less rounded and hence more subangulate at side, than in the male, but this does not hold in all cases even within a species.

The colour may be either black or brown in mature specimens. It should be noted, however, that individuals of the black species may be found of varying shades of yellow or brown depending on their state of maturity.

Frequently, females may be distinguished from hornless and unsculptured males by the fact that in the female the space between the eyes where the horn arises in the male is slightly elevated and bi-tuberculate, slightly elevated but not bi-tuberculate in the hornless males.

The most useful characters for the separation of species are: colour; the angles and sinuation at apex and base of thorax; shape of sides of thorax; the movability or immovability of the horn; the length and puncturation of the eleventh stria; and, most important, the male genitalia.

The pronotal apical angles may be acute, right or obtuse, the basal may be obtuse or about right, either broadly or rather narrowly rounded. The sinuation at base of pronotum near the hind angles may be rather sudden and close to the hind angles, or much more gradual and farther away.

The horns may be either apparently fixed or apparently movable. I use the word "apparently" because in some cases only an examination of the insect in life or before drying would show beyond doubt the true character of the horn. In this paper, however, the term "fixed" is used to indicate those cases in which the horn slopes broadly and insensibly laterally and anteriorly into the head; is not excavated at base in front but slopes forward some distance to the suture; and has no deep depression behind. (See Figure 1.).

In those cases in which the horn is said to be "movable," it enters the head much more perpendicularly laterally; is separated laterally and posteriorly from the ordinary substance of the head by an area in which the texture is apparently

less solid, though there is usually a narrow projection formed of the harder material from the anterior basal corners of the horn, joining it to the hard surface of the head; is excavated at base anteriorly as if to permit of a forward movement; and when the horn is pointing backwards there is a depression behind its base which frequently extends laterally of the horn and forms the area of different texture mentioned above. (See Figure 2.).

The species with fixed horns are: *obesus* Lec.; *falli* sp. nov.; *cornigerus* Melsh.; and *liebecki* sp. nov. Those with movable horns are: *mobilicornis* Fab. (European); *thoracicornis* sp. nov.; *filicornis* Say; *simi* sp. nov.; *darlingtoni* sp. nov.; and probably *floridensis* sp. nov.

The male genitalia consist of the usual two lateral and a medial lobe. The lateral lobes show some differences but are so soft and therefore tend so much to distort in drying that I have not attempted to use them. The medial lobe is strongly chitinized and holds its shape better. It is, however, hollow, split for at least part of its length, and filled with a substance that occasionally protrudes, in this way sometimes altering the true outline.

The medial lobe is always strongly curved and "hook" shape, the short or "point" end of the hook being its base.

In order to see the middle lobe clearly it is advisable, after extraction of the genitalia, to slice off with a scalpel one or other of the lateral lobes and glue the part with the medial lobe on a point in such a way that it is turned as nearly as possible 90° from its true position.

The material examined, even though specimens from the district, excepting Kansas, between the Mississippi and the Rocky Mountains, and from the more southerly half of the States east of the Mississippi and west of the Appalachians were largely lacking, is without doubt by far the most extensive ever gathered together. For this state of affairs it is a pleasure to acknowledge the courtesy and generosity with which loans of material were made.

The great Museums which loaned material were:—The U. S. National Museum, through Messrs. P. de B. Ravenel and Fisher; the Canadian National Museum, through Mr. Arthur Gibson, Dominion Entomologist; the American Museum of Natural History through Mr. Andrew Mutchler; the Brooklyn Museum, through Mr. Schaeffer; the Academy of Natural Sciences, Philadelphia, through the kindness of the late Dr. Henry Skinner; the Museum of Comparative Zoology, through Dr. Nathan Banks, and Cornell University through Mr. Frank C. Fletcher.

Nor were private individuals less kind, and the following gentlemen lent me their entire series in the genus:—Messrs. H. C. Fall, of Tyngsboro, Mass.; C. A. Frost of Framingham, Mass.; Chas. Liebeck, Philadelphia; H. F. Wickham, Iowa City; Howard Notman, New York City, Warren Knaus, McPherson, Kansas; F. S. Carr, Medicine Hat, Alta.; W. J. Brown, now of the Dominion Entomological Staff; R. W. Dawson, University of Minnesota, C. Mickle of the University of Minnesota; Normal Criddle, Treesbank, Man.; R. M. Sim, Moorestown, N. J.; Ralph Hopping of the Canadian Entomological Service; Chas. Dury, Cincinnati; the late K. F. Auden, Vancouver, B. C.; K. F. Chamberlain, Cornwall, Conn. To all of these and to others whose help was different only in degree, I extend my sincere thanks.

In addition to thanks for loan of material, I wish to record my indebtedness in especial to Mr. Norman Criddle, for making notes and copying descriptions from sources not available to me; to Mr. W. J. Brown for notes on the authorities for the genus, to Mr. P. J. Darlington for drawings and exhaustive comparative notes on the type and homotype of *cornigerus*, and for an examination of the Harris material; to Dr. H. C. Fall for a critical examination of *cornigerus* type and copious notes on many points; and to Mr. Chas. Liebeck, who has taken a most kindly and enthusiastic interest in my study. In touch as he was with the great Dr. Horn, he has been able to interpret the point of view of the older entomologists. In addition, he delved into old literature, sending me notes of the greatest value and interest, made a close study and reported on the material in the Horn collection; assisted me in securing material from others; and was never too busy to give me a word of encouragement or advice. Mr. R. J. Sim, as will have been evident from the preceding pages, has been most enthusiastic in giving me assistance. Not only has he sent me specimens of the species, *simi*, *darlingtoni*, and *liebecki*, to the number of several hundred, but he has made many interesting notes on the behaviour of these beetles.

KEY TO THE SPECIES OF ODONTAEUS

1. Elytra in both sexes rather densely and very finely punctulate .. *obesus* Lec.
   Elytra in neither sex densely punctulate ..... 2.
2. (a) Colour black, sometimes slightly metallic or pitchy, when mature. (Immature specimens varying from pale testaceous to brownish piceous, are frequently taken, especially by digging.) Margins of elytra subexplanate, wide for the genus. Horn of male fixed. (See Fig. 1). Lateral thoracic elevations compressed longitudinally .... *falli* sp. nov.
   (b) Colour black. Margins of elytra narrower. Horn of male movable. (See Fig. 2). Lateral thoracic elevations stout reflexed horns. (European) ..... *mobilicornis* Fab.
   Colour never black. Margins of elytra narrower ..... 3.
3. Middle lobe of male genitalia linear, very much longer—twelve or more times —than wide at middle of length. (See Fig. 5). Fully armed males with thoracic horns ..... *thoracicornis* sp. nov.
   Middle lobe of male genitalia linear and evenly "hook" shaped but not more than about ten times as long as wide at middle of length. (See Figs. 6, 7 & 8) ..... 4a, 4b, 4c.
4. a. Front margin of clypeus much emarginate, almost bilobed, the raised edge continued caudad to form a strongly elevated carina. (See Fig. 12) ..... *floridensis* sp. nov.
   Front margin of clypeus as usual in the genus ..... 4b, 4c.
   b. Sinuation of apex of thorax within the anterior angles rather abrupt, making these angles somewhat acute. Width of thorax at apex very nearly the greatest width of head, the apical angles almost meeting the free margin of the head at its termination at the eye. (See Fig. 13a. 13b). Basal angle obtuse and sinuation of base within rather feeble. (See Fig. 15.) Hind tarsal claw and last joint longer than in *simi*. (See Figs 17a, 17b, 18a 18b) ..... *filicornis* Say.
   c. Sinuation of apex of thorax within the anterior angles less abrupt mak-

ing these angles right. Width of thorax at apex a little more than the greatest width of head, the apical angles not almost meeting the free margin of the head at its termination at the eye. (See Figs. 14a, 14b). Basal angles about right and sinuation at base within pronounced. (See Fig. 16). Hind tarsal claw and last joint shorter than in *filicornis*. (See Figs. 17a, 17b, 18a, 18b) ..... *simi* sp. nov.

Middle lobe of male genitalia not as in 4 ..... 5.

5. Middle lobe of male genitalia compressed in the vertical plane, about ten times as long as wide at middle of length, distinctly curved upwards at tip, sigmoid. (See Fig. 9) ..... *cornigerus* Melsh.

Middle lobe of male genitalia not as above ..... 6.

6. Middle lobe of male genitalia compressed in the vertical plane, not, or very little, curved upwards at tip. Short for the genus, not more than six times as long as wide at middle. (See Fig. 10) ..... *liebecki* sp. nov.

Middle lobe of male genitalia not as above ..... 7.

7. Middle lobe of male genitalia very abruptly bent at base so that space in the "Hook" is very narrow. (See Fig. 11) ..... *darlingtoni* sp. nov.

SPECIES OF ODONTAEUS, DEJ.

Odontaeus obesus Lec.

Odontaeus obesus Lec., Proceedings of the Academy of Natural Sciences, Philadelphia, p. 282-283, - 1859 - Vol. XI.
Odontaeus obesus Lec. (Horn, Transactions American Entomological Society, Vol. III.).

(Original description).

"Rotundato-ovatus, valde convexus, piceo-niger, nitidus, thorace basi rotundata versi angulos, vix sinuata, angulis postices rectis, elytris striis fortiter crenatis, antennis piceis. Long 45.

Femina capite dense rugose punctato, tuberculo paras frontali, plicaque verticali signato; thorace punctato, tuberculis duobus anticis plicaque transversa munito, Mas latet."

Table Mountain below San Francisco: Mr. Davidson.

"Very much larger than any of the other species of the Genus. The male is one of the finest entomological prizes which will reward the collector in Western America. Differs from our other two species by the colour and by the base of the thorax being less sinuate, whereby the posterior angles become more rectangular."

Dr. Horn, in the paper cited above, points out that the lateral thoracic elevations are acute, and that the horn is fixed.

There is a considerable range of variation shown in the long series examined, but I am unable to define geographical races though specimens from the more northern part of its range usually have the lateral thoracic elevations less prominent. Shape is more variable in this than in the other species, the strongly developed males being usually broader than is the case in the males lacking in the secondary sexual characters.

This species, so far as is now known, can always be told from the other species of the genus by its minutely and quite densely punctulate elytra. The medial lobe of the genitalia is of the linear type. (See Fig. 3.).

The type is in the museum of Comparative Zoology at Cambridge, Mass.

Obesus has a range extending from British Columbia to New Mexico. Apparently it occurs most frequently nearer the Coast, but has turned up most unexpectedly in Utah, and at Buena Vista, Colorado, this latter locality being on the eastern slope of the divide.

Material Examined: 120 specimens.

Localities: British Columbia, California, Oregon, Washington, Idaho, Utah, New Mexico, Colorado. The largest number of specimens, fifty-nine, is from British Columbia. California is well represented by twenty-nine, but Utah and Colorado have but three, New Mexico (Mescalera Res.) two, and Idaho (Coeur d'Alene, June H. F. Wickham) but one.

(To be continued)

TWO NEW NAMES IN ONTHOPHAGUS.

BY W. S. BLATCHLEY,
Indianapolis, Ind.,

In the Canadian Entomologist, Vol. XLVIII, 1916, p. 94, I described as new *Onthophagus nigrescens* from Dunedin, Florida. In the same periodical, Vol. LI, 1919, p. 31, I described *Onthophagus alutaceus*, also from Dunedin. These two species are, respectively, the numbers 13085 and 19946 of the Leng Catalogue and Supplement.

It seems that I was unfortunate in the choosing of both specific names as Mr. W. J. Brown, Assistant Entomologist in charge of Coleoptera of the Entomological Branch at Ottawa, has kindly informed me that both names are preoccupied as follows:

O. nigrescens Blatch. by *O. nigrescens* D'Orbigny (Ann. Soc. Ent. Fr., LXXI, 21, 1902).

O. alutaceus Blatch. by *Copris alutaceus* Wiedemann. (Zool. Mag., 11, (1), 14, 1823); this species being listed as *Onthophagus alutaceus* Wiedm. in the Munich Catalogue.

I therefore herewith propose the new names ONTHOPHAGUS FLORIDANUS for *O. nigrescens* Blatch. and ONTHOPHAGUS ACICULATULUS for *O. alutaceus* Blatch.

Mailed Saturday, June 2nd.